



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS

In Re Application of:)
)
Inventors: Apostolos Voutsas)
)
Serial No.: 09/893,866) Attorney docket No.:
) SLA592
Filed: June 28, 2001)
)
Title: METHOD FOR FORMING) Group Art: 5636
SILICON FILMS WITH TRACE) Confirmation No. 5636
IMPURITIES) Examiner: A. Sarkar
_____) Customer No. 29397

CERTIFICATION UNDER 37 CFR § 1.8

I hereby certify that the documents referred to as enclosed herein are being deposited with the United States Postal Service as first class mail on this date 12/23/2003 in an envelope addressed to: Commissioner for Patents, Alexandria, VA 22313-1450.

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BRIEF ON APPEAL - RESPONSIVE TO
A NOTICE OF DEFECTIVE APPEAL BRIEF

This paper is an appeal from the rejection by Examiner Asok Sarkar, Group Art 5636, of claims 1-23, set forth in Appendix A, all claims in the application. The Appeal Brief is being resubmitted in its entirety, in response to a Notice of Defective Appeal Brief dated December 16, 2003. Appendix A has been replaced to reflect the status of the claims as of the Final Office Action dated July 31, 2002.

REAL PARTY IN INTEREST

The real party in interest is Sharp Laboratories of America, Inc., as assignee of the present application by an Assignment recorded in the United States Patent Office on June 28, 2001 at Reel 011980, Frame 0374.

RELATED APPEALS AND INTERFERENCES

None.

STATUS OF THE CLAIMS

Claims 1-23 are in the application.

Claims 1-23 are rejected.

Claims 1-23 are appealed.

STATUS OF AMENDMENTS

Amendments were made to claims 2, 4-6, 9, 15, 17-19, and 22 in an Office Action response filed on June 18, 2002. These amendments were entered. In a Final Office Action dated July 31, 2002, the Examiner objected to claims 6, 19, and 22, and stated that appropriate correction was required. In a Response filed September 19, 2002, the Applicant amended claims 6, 19, and 22 as requested, as well as claim 9 (for the same issue). The Advisory Action of October 2, 2002 stated, however, that the amendments would not be entered. An Appeal Brief was initially submitted (filed November 4, 2002) showing the above-mentioned unentered claim amendments. Appendix A of the instant (resubmitted) Appeal Brief reflects that status of the claims as of the Final Office Action of July 31, 2002.

SUMMARY OF THE INVENTION

Please refer to Figs. 2, 3, and 4, and the description at page 8, beginning at line 16, through page 13, line 15. As set forth on page 9, beginning at line 22, the present invention begins with a silicon target including a first concentration of impurities. In some aspects, the target is single-crystal silicon. An amorphous silicon film is formed by sputter deposition of the target. The resultant film includes a second concentration of the (target) impurities. The impurities can include metals, such as nickel (Ni), or phosphorous, or germanium. In some aspects, the first (and second) impurities are a combination of Ni and phosphorous.

Additional steps in the method may include: annealing the resultant amorphous silicon film to form Ni silicide; and, annealing to form a crystallized silicon film.

As shown in Fig. 2, one use of the present invention eliminates separate process steps of: depositing Ni on silicon film, diffusing the Ni into the silicon film, and removing the excess Ni, prior to crystallizing the Si film.

THE ISSUES

1. Whether claims 1-3, 12, and 14 are anticipated under 35 U.S.C. 102(b) by Zhang (US 5,569,936).
2. Whether claims 4, 5, 11, 13, 15, and 16-18 are obvious under 35 U.S.C. 103(a) with respect to Zhang.
3. Whether claims 6, 8, 9, 19, 21, and 22 are obvious under 35 U.S.C. 103(a) with respect to Zhang in view of Yamazaki (US 6,306,694).

4. Whether claims 7, 10, 20, and 23 are obvious under 35 U.S.C. 103(a) with respect to Zhang, in view of Yamazaki, and further in view of admitted prior art (APA).

THE GROUPING OF THE CLAIMS

The claims are grouped as follows:

Claims 1-11 stand or fall together.

Claims 12-23 stand or fall together.

ARGUMENT AND DISCUSSION

Claims 1-3, 12, and 14

Claims 1-3, 12, and 14 have been rejected under 35 U.S.C. 102(b) as being anticipated by Zhang (US Patent 5,569,936). The Final Office Action states that Zhang teaches a method for forming an LCD device by:

forming a target including silicon and a first concentration of impurity (col. 3, ln. 60-65) of transition metals, such as Ni (col. 3, ln. 50-53);

supplying a substrate; and,

sputter depositing an amorphous Si film with a (controlled) second concentration of impurity.

“A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987).

Zhang, in a single line of the Summary (col. 3, ln. 62-65), mentions that amorphous silicon can be formed by sputtering, and that a

catalyst can be added in the target material. However, a single mention of prior art Si targets with added catalysts does not adequately teach the claimed invention step of forming a Si target with a first concentration of impurities. For example, no mention is made of the concentration of impurities to be added to the target.

The subject of Zhang's invention is the formation of Si films through chemical vapor deposition (CVD) processes. Unlike the sputtering process, which breaks particles away from the target and induces them to form a film over a charged substrate, the CVD process "condenses" particles onto a substrate from a gaseous compound. In the detailed description of the preferred embodiments, Zhang specifically describes four production process embodiments. However, none of these embodiments mention the use of a silicon target, embedded with impurities, to form a silicon film, as is recited in the claimed invention. In the first embodiment (col. 6, ln. 10-11), second embodiment (col. 7, ln. 18-20), third embodiment (col. 8, ln. 41-42), and fourth embodiment (col. 10, ln. 2-4), amorphous silicon is deposited using a CVD process. In short, Zhang does not enable one skilled in the art to use a silicon target including impurities to form a silicon layer as the claimed invention recites in claims 1 and 12.

To anticipate, the reference must also enable one of skill in the art to make and use the claimed invention. In re Donohue, 766 F.2d 531, 533, 226 USPQ 619, 621 (Fed. Cir. 1985). Zhang, at col. 3, ln. 60-65, states "...in the case of forming an amorphous silicon film by a physical gas phase method like sputtering, these catalysts can be added in a deposition material like target of deposition source." This one-line mention of sputtering by Zhang clearly does not enable one skilled in the

art to perform the steps that are recited in the claimed invention. Neither does Zhang's detailed description of CVD processes enable one to perform the claimed invention sputtering process.

The invention of claim 1 states that the target has a first concentration of a first impurity, and that the resultant silicon film includes a second concentration of the first impurity. The invention of claim 12 recites the sputter deposition of a controlled amount of impurities. Zhang does not teach the use of a particular concentration of impurities in the target, selected to achieve the desired concentration of impurities in the resultant silicon film. Zhang does not describe the concentration of impurities required in the silicon target. Alternately stated, Zhang does not a relationship between the first concentration of impurities in the target and the second concentration of impurities in the resultant film. Therefore, Zhang does not teach all the elements of the invention of claims 1 and 12, and cannot anticipate the claimed invention. Claims 2, 3, dependent from claim 1, and claim 14, dependent from claim 12, also benefit from the above-mentioned distinctions between the prior art reference and the claimed invention.

Claims 4, 5, 11, 13, 15, and 16-18

Claims 4, 5, 11, 13, 15, and 16-18 have been rejected as obvious under 35 U.S.C. 103(a) with respect to Zhang. The Final Office Action states that Zhang "teaches forming the amorphous silicon film from a composite target of silicon and impurity Ni having a concentration of 10^{17} atoms/cm³ in between column 3, line 46 and column 4, line 17." In fact, this cited section does not mention the concentration of impurities in the target material, but only the concentration in the resultant film

layer. Further, the Examiner acknowledges that “Zhang fails to expressly teach forming the Si target with single crystal silicon and first Ni concentration of 0.01 - 0.5 atom% and then depositing an amorphous Si film containing a second Ni concentration.” The Office Action states, however, that it would have been obvious to one skilled in the art to form an amorphous silicon film with a second concentration of Ni using a single crystal target with a first concentration of Ni. The Office Action also states that that it would have been obvious to judiciously adjust process parameters, citing MPEP 2144.05.

An invention is unpatentable if the differences between it and the prior art would have been obvious at the time of the invention. As stated in MPEP § 2143, there are three requirements to establish a *prima facie* case of obviousness.

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

Generally, as mentioned above, Zhang teaches a process (or four processes) that involves the CVD deposition of amorphous silicon film. Only in one line is the possibility of using a target to sputter deposit amorphous silicon even mentioned. Although the Office Action states that it would have been obvious for one skilled in the art to “form amorphous film with a second Ni concentration from a composite target of single crystal silicon and a first Ni concentration of 0.01 – 0.5 atom%....”, there is no suggestion in Zhang that any particular concentration of Ni be used

to form targets. That is, Zhang does not describe any details sufficient to enable one to build a target with the first concentration of Ni.

“Any judgment on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning, but as long as it takes into account only knowledge which was within the level of ordinary skill in the art at the time the claimed invention was made and does not include knowledge gleaned from applicant’s disclosure, such as reconstruction is proper.” *In re McLaughlin* 443 F.2d 1392, 1395, 170 USPQ 209, 212 (CCPA 1971). There is no evidence in the Zhang reference that a target having a Ni concentration of 0.01 to 0.5 at% was known. The Applicant respectfully submits that the cited prior art is only modified in retrospect, in light of the present invention. Neither does the Final Office Action provide any motivation to support the obviousness rejection. Alternately stated, the Examiner fails to show how Zhang makes obvious a first Ni concentration of 0.01 – 0.5 atom% in the silicon target.

The Office Action also states “that the specification contains no disclosure of either the critical nature of the claimed processes or any unexpected results arising therefrom. Where patentability is said to be based upon particularly chosen methods or upon another variable recited in a claim, the Applicant must show that the chosen method or variables are critical ...” In response, the Applicant notes that page 8, ln. 5-15, of specification discusses the issue of sputtering yield. The specification states that the sputtering yield of Ni is 2-3 times higher than the sputtering yield for Si. The recognition of these yields is reflected in the claimed processes, and the recited relationship between the first and second concentrations.

In response to the “optimization of ranges” rejection (MPEP 2144.05 II), the Applicant notes that the cited MPEP section states that the prior art reference must present either a broader or alternate range of variables. However, the Examiner has not cited any reference that discusses the concentration of impurities in the target material. Neither has the Examiner presented any references that discuss a process of controlling the relationship between the concentration of impurities in the target and the concentration of impurities in the resultant film. That is, the reference does not disclose any variables related to the first concentration of impurities in the target.

The Examiner has not demonstrated that the modification of the cited the prior art reference points to the reasonable expectation of success in the present invention, which is the second requirement of the obviousness analysis. In the RESPONSE TO ARGUMENTS Section of the Final Office Action, a reference is presented (Bunshah), which the Examiner states, teaches that the concentration of catalysts in the resultant film is different than the concentration of catalysts in the target. However, this reference does not appear to explain the first concentration of impurities needed in a silicon target, to form a silicon film with a second concentration of impurities through a sputter deposition process. Alternately stated, the Bunshah reference does not point to an expectation of success in the claimed invention.

With respect to the third requirement to support a *prima facie* case of obviousness, as noted in the response to the anticipation rejection, Zhang does not describe all the elements of either claim 1 or 12. That is, Zhang does not teach the use of a particular concentration of impurities in the target, selected to achieve the desired concentration of

impurities in the resultant silicon film. Zhang does not describe the concentration of impurities required in the silicon target, or the relationship between the first and second concentrations. Neither has the Examiner proven that these target concentration levels were well known to those skilled in the art at the time of the invention. Zhang neither suggests, nor teaches all the elements of claims 1 or 12. Claims 4, 5, and 11, dependent from claim 1, and claims 13 and 16-18, dependent from claim 12, enjoy the same benefits as the independent claims.

Claims 6, 8, 9, 19, 21, and 22

Claims 6, 8, 9, 19, 21, and 22 have been rejected under 35 U.S.C. 103(a) as obvious with respect to Zhang, in view of Yamazaki (US Patent 6,306,694). In the Final Office Action, the Examiner acknowledges that Zhang fails to disclose the use of a third concentration of phosphorous (P) in the target, and a fourth concentration of P in the deposited film sufficient to create a V_{th} shift. The Examiner also acknowledges that Zhang fails to teach a first concentration of Ge in the target to form a Si film with a second concentration of Ge and a fourth concentration of P. The Final Office Action states that Yamazaki teaches the use of Ge as a crystallization catalyst and the use of dopants to control threshold voltages, and that it would have been obvious to combine the two references so as to make the claimed invention obvious. The Examiner also states that it would have been obvious to judiciously adjust process parameters, again citing MPEP 2144.05.

Yamazaki describes several processes for forming TFTs suitable for use in an active matrix LCD. The first embodiment describes the deposition of amorphous silicon film "by a known deposition method"

and mention is made of a silicon germanium film (col. 7, ln. 24-30). The second embodiment begins at Fig. 4, at a step in the process subsequent to the step of depositing amorphous silicon (col. 17, ln. 60-63). Likewise, the third embodiment begins at Fig. 7, at a higher process level (col. 18, ln. 33-34). Embodiment 4 is the same as the first embodiment (col. 19, ln. 33-35), except for the formation of film 104 (col. 19, ln. 40-43), a step that occurs after the deposition of amorphous silicon. Likewise, the fifth embodiment is the same as the first embodiment, and describes differences that occur after the deposition of amorphous silicon (col. 20, ln. 4-9). Embodiment 6 deals with modifications in the laser annealing step (col. 20, ln. 48-51). Embodiments 7 and 8 describe the formation of a protective film overlying the crystallized silicon (col. 21, ln. 19-22 and col. 22, ln. 7-10). Embodiment 9 is similar to embodiment 7 (col. 22, ln. 53-55). Embodiment 11 mentions a CVD process to deposit amorphous silicon (col. 23, ln. 41-44).

In summary, there are a total of 47 embodiments described by Yamazaki. However, none of the embodiments describe an amorphous silicon deposition process that differs from the first embodiment, and the first embodiment just describes deposition by a "known technique". More specifically, Yamazaki does not describe an amorphous silicon sputtering process, or the use of target impurities to form an amorphous silicon film with impurities. When Yamazaki adds impurities, they are always added in a process performed subsequent to the deposition of the amorphous silicon film. For example, in embodiment 25 a catalytic agent is added in an aqueous solution over the surface of the amorphous silicon (col. 32, ln. 23-31). Likewise, the addition of dopants to specific areas of a subsequently formed transistor are described (col. 4, ln. 13-33). The

sputter deposition of an amorphous silicon film including impurities is not described. The claimed invention is different from Yamazaki in that the impurities are deposited as the film is being formed.

The RESPONSE TO ARGUMENTS Section of the Final Office Action states that Yamazaki “teaches that Ni can be used as a catalyst for crystallizing Si...”. However, the Examiner has not provided a motivation to combine the Zhang and Yamazaki references. Zhang already teaches that Ni can be used as a catalyst for crystallization. “Therefore, an examiner may often find every element of a claimed invention in the prior art. If identification of each claimed element in the prior art were sufficient to negate patentability, very few patents would ever issue....To prevent the use of hindsight based on the invention to defeat patentability of the invention, this court requires the examiner to show a motivation to combine the references that would create the case of obviousness. In other words, the examiner must show reasons that the skilled artisan, confronted with the same problems as the inventor and with no knowledge of the claimed invention, would select the elements from the cited prior art reference for combination in the manner claimed.” *In re Rouffet*, 47 USPQ2d 1453, 1457-1458 (1998).

Further, even if the references could be combined, there is nothing in the Yamazaki disclosure to suggest a modification of Zhang in a way makes the claimed invention of either claim 1 or claim 12 obvious. That is, there is no suggestion in Yamazaki to form a target with a first concentration of impurities necessary to form a second concentration of impurities in a deposited silicon film. Neither reference teaches to use of a target with a first concentration of impurities being used to form a Si film with a second concentration of the impurity. For the Examiner to

simply state that Yamazaki teaches to use of Ni as catalyst and that “various forms of sputtering and DC sputtering process is well known in the art” is not proof of motivation. For example, with respect to claim 6, the Examiner must prove motivation in the prior art that silicon nickel target further include an additional third concentration of phosphorous less than 5×10^{17} atoms/cm³ to create a silicon film with an additional concentration of phosphorous sufficient to create a V_{th} shift in the silicon film.

In Section 10 of the Final Office Action (RESPONSE TO ARGUMENTS), the Examiner states that the motivation to combine references comes from the fact that “the use of sputtering process, target composition and material characteristics are well known in the semiconductor industry.” The Applicant notes that such logic would permit the combination of any two patents, for the purpose of obviousness analysis, that even mention the sputtering process.

In response to the Examiner’s argument that the claimed invention process is made obvious by judiciously adjusting process parameters disclosed in the prior art references (MPEP 2144.05), the Applicant again notes that the references must disclose either a broader or alternate range of variables. Neither reference discloses a range of value for the first concentration of impurities in the target.

Neither has the Examiner demonstrated that the modification of the combined prior art references point to the reasonable expectation of success in the present invention, which is the second requirement of the obviousness analysis.

The third requirement to support a *prima facie* case of obviousness requires that the combined references disclose all the

elements of the claimed invention. However, the convention amorphous silicon deposition processes of Yamazaki, when combined with Zhang still does not teach the use of a particular concentration of impurities in the target, selected to achieve the desired concentration of impurities in the resultant silicon film, or describe the concentration of impurities required in the silicon target. Neither reference describes any kind of Si film sputtering process in detail. Claims 6, 8, 9, dependent from claim 1, and claims 21 and 22, dependent from claim 12, also benefit from the above-mentioned distinctions.

Claims 7, 10, 20, and 23

Claims 7, 10, 20, and 23 have been rejected under 35 U.S.C. 103(a) as obvious with respect to Zhang, in view of Yamazaki and the APA (US Patent 6,149,784, Su). The Examiner acknowledges that neither Zhang nor Yamazaki teach DC sputtering, but that the combination of the DC sputtering process described by Su, combined with Zhang and Yamazaki make the claimed invention obvious.

Su describes the use of a shield that can be added to a DC magnetron sputtering reactor to protect the chamber walls from being coated with sputtering material (col. 3, ln. 45-49). Su does not describe the use of silicon targets made with particular concentrations of impurities, or specifics of an amorphous silicon deposition processes.

Again there appears to be no motivation to combine the three references. "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). Neither has it been demonstrated

that the modification of the combined prior art references point to the reasonable expectation of success in the present invention, which is the second requirement of the obviousness analysis.

The third requirement to support a *prima facie* case of obviousness requires that the combined references disclose all the elements of the claimed invention. However, the DC sputtering process of Su, combined with the convention amorphous silicon deposition processes of Yamazaki and Zhang, still does not teach the use of a particular concentration of impurities in the target, selected to achieve the desired concentration of impurities in the resultant silicon film, or describe the concentration of impurities required in the silicon target. Claims 7 and 10, dependent from claim 1, and claims 20 and 23, dependent from claim 12, also benefit from the above-mentioned distinctions.

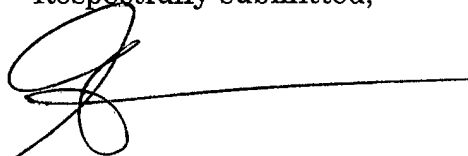
SUMMARY AND CONCLUSION

It is submitted that for the reasons pointed out above, the claims in the present application clearly and patentably distinguish over the cited references. Accordingly, the Examiner should be reversed and ordered to pass the case to issue.

A check for \$320 has already been submitted (10/30/2002).

Authorization is given to charge any deficit or credit any excess to Deposit
Account No. 502033.

Respectfully submitted,

A handwritten signature in black ink, consisting of a large, stylized 'G' followed by a horizontal line extending to the right.

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Date: 12/19/2003

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